

REMARKS

By this amendment, claims 1, 2, 7, 8, and 11 are amended. The amendments are made to even more clearly recite the claimed invention and do not add new matter and are fully supported by the specification. Reconsideration of the rejected claims in view of the above amendments and the following remarks is respectfully requested.

Interview Summary

Applicants would like to thank Examiner Hanley for her courtesy in conducting a telephone interview with Applicants' representatives, Azza Jayaprakash and Sean Myers-Payne, on November 8, 2007. In the telephone interview, Applicants' representatives discussed the rejections in the outstanding Office Action.

With regard to the objections to the specification, the Examiner suggested that the objection could be overcome by submitting documents (published before the filing of the present application) found on the internet or the USPTO patent database, which support the generic terminology for the trademarks recited in the specification.

Regarding the rejection under 35 U.S.C. 112, first paragraph, the Examiner suggested that the rejection could be overcome by amending the claims to recite the generic terminology for the resins (without reciting the trademarks).

As for the rejection under 35 U.S.C. 112, second paragraph, the Examiner reconsidered the claimed carbonaceous synthetic absorbents and determined that the scope of the claims was clear. Thus, the Examiner indicated that she would withdraw the rejection. The Examiner also recommended amending claim 7 to recite "the resin" or "said resin" (rather than "it").

The Examiner then addressed the art-based rejections. The Examiner suggested that she would be amenable to arguments or a declaration establishing that the claimed invention yields unexpected results. Such arguments might address why the high level of purity is unexpectedly good. The Examiner also suggested presenting arguments regarding the lack of motivation to combine the cited art. The Examiner also indicated that she might consider arguments regarding why the order of purification is important. The Examiner further recommended finding art which establishes the difficulty of purifying teicoplanin or similar antibiotics.

Lastly, the Examiner addressed her concerns regarding the term “pre-purification” in claim 1. The Examiner asserted that this term was unclear, and suggested amending the claims to recite “primary purification,” “secondary purification,” and “tertiary purification.”

Applicants thank the Examiner for providing guidance on each of the rejections, and have taken the Examiner’s comments into consideration when preparing the present response.

Objections to the Specification

The Office Action objects to the amendments made to the specification in the prior amendment, alleging that the “lack of generic language forces the reinstatement of the original objection to the specification” (on the grounds that the trademark names should be accompanied by their generic terminology). The Examiner suggests that the trademark names, as well as the generic terminology, can be joined by providing evidence to the Patent Office that the “generic name of the trademarked resins was inherent at the time of the instant invention.”

Therefore, Applicants have amended the specification to include the generic terminology for DIAION SP700, DIAION SP825, DIAION SP850, DIAION SP207, DIAION HP2MG, DIAION SK1B, DIAION PK216, TRILITE SPC 160H, TRILITE SPC 180H, DIAION CR11,

DIAION CR20 (manufactured by Samyang Corp.), and submit herewith product specifications for these trademarked resins. Applicants also submit herewith a letter from Mr. Yoon-Beom Ham of Samyang Corporation, indicating that the attached product specification is the “First English Edition issued on June 16, 1999” (according to the attached English language translation of the original letter in Korean). The attached product specification supports the generic terminology for DIAION SP700, DIAION SP825, DIAION SP850, DIAION SP207, DIAION HP2MG, DIAION SK1B, DIAION PK216, DIAION CR11, DIAION CR20, TRILITE SPC 160H, and TRILITE SPC 180H (manufactured by Samyang Corporation) recited in the specification. Please refer to the attached Index for a list of page numbers on which descriptions of the trademarked DIAION products may be found.

As for the other trademarked terms, Applicants were able to find support for these trademarked resins in patent applications (which were filed prior to the filing date of the present application).

For example, “AMBERLITE XAD 4” was described in U.S. Patent No. 4,865,822 (filed October 11, 1988) on col. 6, lines 64-68 (“[a] particularly preferred **macroreticulate polymer** support is poly(**styrene-divinylbenzene**), commercially available as **Amberlite XAD4** (50 Angstrom pore size) and Amberlite XAD2 (100 Angstrom pore size), from Rohm & Haas, Philadelphia, Pa.”). Thus, the generic terminology “macroreticularly cross-linked aromatic polymers” is supported by the description in this publication.

“AMBERLITE XAD 1600T” was described in U.S. Patent No. 6,262,303 (filed April 30, 1999) on col. 5, lines 26-31 (“[t]he process of the invention includes a chromatographic purification on a conventional column comprising a solid phase selected from the group consisting of **macroporous highly cross-linked styrene resins**, preferably **Amberlite® XAD**

1600, **1600 T** and 16 (Rohm & Haas) or equivalents marketed by other manufacturers.”). Thus, the generic terminology “macroreticularly cross-linked aromatic polymers” is supported by the description in this publication.

“AMBERLITE XAD 7” was described in U.S. Patent No. 4,230,625 (filed April 12, 1979) on col. 4, lines 5-9 (“[f]or example yield improvement is obtained when **polymeric resin absorbents** such as **Amberlite XAD7** (Rohm & Haas Co.), a **polymer of the methyl ester of acrylic acid** is added at a concentration 0.3-0.6 wt % to a fermentation medium where the substrate is present in a concentration of up to about 1 g/liter.”). Thus, the generic terminology “macroreticularly cross-linked aliphatic polymers” is supported by the description in this publication.

“AMBERSORB 563” was described in U.S. Patent No. 5,281,257 (filed December 11, 1992) on col. 5, line 58, through col. 6, line 8 (“[s]ome adsorbents are originally synthetic but are essentially made of a **carbonaceous** material [in] their final form. A typical example is Ambersorb™. The Ambersorb materials are prepared from a sulfonated **styrene/divinylbenzene macroreticular ion exchange resin** with a moderate surface area. This resin is then pyrolyzed to form the **carbonaceous** final product...The adsorption media that are used in the present invention have different binding capacities and binding energies...For example, Amberlite™ XAD-16, **Ambersorb™ 563**...”). Thus, the generic terminology “carbonaceous synthetic adsorbents comprising a high porosity styrene/divinyl benzene ion exchange resin” is supported by the description in this publication.

“AMBERSORB 572” was described in U.S. Patent No. 7,037,642 (filed October 5, 2001) on col. 14, lines 48-56 (“[i]n one preferred embodiment the adsorbent particles are activated carbons derived either from natural or synthetic sources. Preferably the activated carbons are

derived from synthetic sources. Nonlimiting examples of **activated carbons** include; Picatiff Medicinal.RTM., which is available from PICA USA Inc. (Columbus, Ohio), Norit.RTM. ROX 0.8, which is available from Norit Americas, Inc. (Atlanta, Ga.), **Ambersorb™ 572**, which is available from Rohm & Haas (Philadelphia, Pa.)”). Thus, the generic terminology “carbonaceous synthetic adsorbents comprising a high porosity styrene/divinyl benzene ion exchange resin” is supported by the description in this publication (and the description of AMBERSORB products in 5,281,257, discussed in the previous paragraph).

“AMBERSORB 600” was described in U.S. Patent No. 5,676,738 (filed August 22, 1995) on col. 2, lines 33-40 (“FIG. 1 illustrates the overall novel concept incorporating the use of a new spherical, pyrolyzed, **synthetic carbonaceous adsorbent** in a fluidized bed or moving bed volatile organic compound (VOC) control and/or recovery system. The type of adsorbent is exemplified by, but not limited to, adsorbents such as Rohm and Haas “Ambersorb 563” and, in particular, **“Ambersorb 600,”** is one suitable form of the product for this application.”). Thus, the generic terminology “carbonaceous synthetic adsorbents comprising a high porosity styrene/divinyl benzene ion exchange resin” is supported by the description in this publication (and the description of AMBERSORB products in 5,281,257, discussed above).

“LEWATIT VP OC 1064” and “LEWATIT VP OC 1066” are both described in U.S. Patent Application Publication No. 2003/0105344 (filed April 1, 2002) in paragraph [0048] (“[o]ther adsorber resins are...Lewatits (**crosslinked polystyrenes**) such as **Lewatit OC 1064**, **Lewatit OC 1066...**”). Thus, the generic terminology “high porous styrene/divinyl polymers” is supported by the description in this publication.

“LEWATIT EP 63” is described in U.S. Patent No. 7,169,757 (filed January 16, 2003) in col. 2, lines 62-65 (“[p]referably, said hydrophobic resin may be selected from the group

consisting of ...**LEWATIT™ EP-63 polystyrene-divinylbenzene-copolymer resin...**"). Thus, the generic terminology "high porous styrene/divinyl polymers" is supported by the description in this publication.

"**AMBERLITE CR1310 NA**" is described in U.S. Patent No. 7,098,013 (filed November 16, 2001) in col. 35, line 66, through col. 36, line 1 ("[t]he resulting saccharide solution was subjected to a column chromatography using **AMBERLITE CR-1310 (Na-form)**, a strong acid **cation-exchanger resin**...The resin was packed into four jacketed stainless steel columns having a diameter of 5.4 cm, which were then cascaded in series to give a total **gel** bed depth of 20 m."). Thus, the generic terminology "gel-type cation exchange resin" is supported by the description in this publication.

"**AMBERJET 200H**" is described in U.S. Patent No. 6,200,479 (filed January 14, 1997) in col. 7, lines 23-25 ("Exemplary strongly acid **cation exchange resins** include the styrene-divinyl benzene sulfonic acid resins such as...**Amberjet 200H**"). Thus, the generic terminology "gel-type cation exchange resin" is supported by the description in this publication.

"**LEWATIT VP OC 1800**" is described in U.S. Patent No. 6,025,504 (filed April 22, 1999) in col. 6, lines 55-58 ("**[a] strong acid resin gel** in the Na⁺ form (trade name "**Bayer Lewatit VP OC 1800**"), pre-swollen in water, was **exchanged** into the Zn⁺⁺ form by percolating a 2N ZnSO₄ solution (5 volumes for 1 volume of resin)"). Thus, the generic terminology "gel-type cation exchange resin" is supported by the description in this publication.

"**LEWATIT MDS1368 NA**" is described in U.S. Patent No. 5,641,406 (filed October 10, 1995) in Table 1 (in col. 13) as a "**gel**" and in col. 15, line 49, as a "**strongly acidic cation exchanger**." Thus, the generic terminology "gel-type cation exchange resin" is supported by the description in this publication.

“PUROLITE PCR833CA” is described in U.S. Patent No. 7,150,885 (filed) in col. 9, line 55, through col. 10, line 5 (“[i]n the present invention, a **gel type ion exchange resin** is preferably used...Such ion exchange resins are commercially available, for example, include...**Purolite series ...PCR833...**”). Thus, the generic terminology “gel-type cation exchange resin” is supported by the description in this publication.

“MFG 210” and “MFG 250” are both described in U.S. Patent No. 6,649,755 (filed April 26, 2002) in col. 4, lines 6-13 (“[t]he monodispersed, strong acid **cation exchanger** used in the method of the present invention is a crosslinked polystyrene-based **gel-type** agent containing a sulfate group in the form of a bead-shaped monodisperse resin packed in a hexagonal bed structure. Also, the cation exchanger has a particle size of 0.15 to 0.3 mm and preferably 0.21 to 0.25 mm. Examples of the cation exchanger include **MFG 210 and MFG 250...**”). Thus, the generic terminology “gel-type cation exchange resin” is supported by the description in this publication.

“AMBERLITE 200C NA” is described in U.S. Patent No. 4,307,257 (filed June 23, 1980) in col. 4, lines 40-45 (“[m]ore preferred are those which are **porous cation exchange resins** having macro pores and extremely large surface area. The cation exchange resins of this kind commercially available include, for example, **Amberlite 200C** (Rohm & Haas Co.)...”). Thus, the generic terminology “porous-type cation exchange resins” is supported by the description in this publication.

“AMBERLITE CG50” is described in U.S. Patent No. 3,939,043 (filed October 21, 1974) in col. 16, lines 47-50 (“The solution is then passed through a column packed with about 500 ml of a **cation exchange resin, Amberlite CG-50** (NH⁴⁺ form).”). Thus, the generic terminology “porous-type cation exchange resins” is supported by the description in this publication.

“LEWATIT VP OC 1812” is described in U.S. Patent No. 6,156,942 (filed December 14, 1998) in col. 4, lines 32-37 (“[e]xamples of commercially available strongly acidic **ion exchange resins** of the sulphonic type are those known by the trademarks...**LEWATIT VP OC 1812**...”). Thus, the generic terminology “porous-type cation exchange resins” is supported by the description in this publication.

“PUROLITE C145” is described in U.S. Patent No. 5,344,976 (filed June 3, 1993) in col. 2 lines 28-34 (“[s]uitable acid-form **cation exchangers** for removing metal ion contaminants in the present invention may comprise strong acid **cation exchange resins** ...**strong acid mesoporous resins**, for example **Purolite C145**...”). Thus, the generic terminology “porous-type cation exchange resins” is supported by the description in this publication.

“LEWATIT K1221” is described in U.S. Patent No. 7,112,702 (filed December 12, 2002) in col. 9, lines 8-14 (“The **ion exchange resin** has an acidic milliequivalent per gram **catalyst value (proton exchange capacity)**, prior to modification, of greater than or equal to about 3.5...**Exemplary ion exchange resin** include, but are not limited to... **Lewatit K1221**...”). Thus, the generic terminology “gel-type catalytic resins” and “gel-type acidic polymer resin” are supported by the description in this publication.

“AMBERLYST 131 WET” is described in the attached Rohm & Haas product specification; please note that the copyright notice is dated 2001. In the product specification, AMBERLYST 131 WET is described as “**solid acid polymer catalyst**.” Thus, the generic terminology “gel-type catalytic resins” and “gel-type acidic polymer resin” are supported by the description in the product specification.

Furthermore, “AMBERLYST 232 WET” is described in the attached Rohm & Haas product specification; please note that the copyright notice is dated 2001. In the product

specification, AMBERLYST 232 WET is described as “**gel type sulphonic acid polymeric catalyst.**” Thus, the generic terminology “gel-type catalytic resin” and “gel-type acidic polymer resin” are supported by the description in the product specification.

In addition, “DIAION UBK555” is described in the attached product specification from a DIAION website (http://www.diaion.com/Diaion_Tables/Diaion_CationTable_R_E.htm); please note that the bottom of the page indicates that the page was last updated on September 30, 2000. In the product specification, DIAION UBK555 is categorized as a “**cation-exchange resin**” and the chemical formula and other properties are provided. Thus, the generic terminology “gel-type cation exchange resins” is supported by the description in this publication.

Lastly, regarding GEL ODS S-15/30, FLASH KP-C18-HS, DAISOGEL 3001A, DMS DM 1020, Applicants note that these resins are categorized as “reversed phase resins” in the specification, and assert that this generic terminology sufficiently describes the trademarked resins as “reversed phase resin[s]...compris[ing] silica containing [a] non-polar side chain having 1 to 18 carbon and having a particle size of 15 to 150 μm ” (as described on page 8 of the specification).

Thus, Applicants invite the Examiner to review the attached product specifications, and respectfully request that the objections be withdrawn. Applicants also respectfully note that the citation of these documents in support of this response should not be considered an admission regarding what is or is not prior art.

Furthermore, Applicants maintain that the other trademarked resins (e.g., “TRILITE SPC 400LH”) in the specification are associated with the generic terminology (previously included in the specification). As the Examiner has required that documentary evidence be provided and

Applicants have been unable to obtain such documentation, Applicants have removed the generic terminology for the other trademarked resins.

Claim Rejections – 35 U.S.C. § 112, first paragraph

The Office Action rejects claims 1, 2, 4, 7-9, 11, and 12 under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement. Specifically, the Examiner asserts that the term “catalytic resin” is not sufficiently described or supported by the specification. Without agreeing with or acquiescing to the rejection, Applicants note that claim 1 has been amended to recite “a resin selected from the group consisting of acidic porous resins comprising a styrene polymer matrix, and acidic cation exchange resins comprising a porous styrene polymer matrix, and gel-type acidic polymer resins” (as recited in the specification and supported by the description of these products in the attached product specifications). Therefore, Applicants respectfully request withdrawal of the rejections.

Claim Rejections – 35 U.S.C. § 112, second paragraph

The Office Action rejects claims 1, 2, 4, 7-9, 11 and 12 under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

Specifically, the Examiner asserts that the term “catalytic resin” in claim 1 is unclear. Without agreeing with or acquiescing to the rejection, Applicants note that claim 1 has been amended to remove the term “catalytic resin,” and have amended the claims to recite “a resin selected from the group consisting of acidic porous resins comprising a styrene polymer matrix, and acidic cation exchange resins comprising a porous styrene polymer matrix, and gel-type acidic polymer resins” (as recited in the specification and supported by the description of these

products in the attached product specifications). Therefore, Applicants respectfully request withdrawal of the rejections.

The Examiner also rejects claim 2. Because the claim recites a carbonaceous synthetic absorbent that includes a styrene/divinyl benzene *ion exchange* resin in the claimed Markush group, the Examiner asserts that it is unclear whether the resin is an absorbent resin or an ion exchange resin. However, during our interview on November 8, 2007, the Examiner reconsidered the rejections, and indicated that this term was indeed clear. The Examiner then indicated that the rejection would be withdrawn. Applicants thank the Examiner for reconsidering her position, and respectfully request withdrawal of the rejections for the record.

Lastly, the Examiner rejects claim 7 because the term “it” lacks sufficient antecedent basis. Without agreeing with or acquiescing to the rejection, Applicants note that claim 7 has been amended to recite “sequentially washing the resin” (rather than “sequentially washing *it*”). Therefore, Applicants respectfully request withdrawal of the rejection.

Claim Rejections – 35 U.S.C. § 103

The Office Action rejects claims 1, 2, 4, 7-9, 11, and 12 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Sawai et al. (U.S. Patent No. 6,391,851) in view of Restelli et al. (U.S. Patent No. 5,539,087), Glass et al. (U.S. Patent No. 4,845,194), Borghi et al. (U.S. Patent No. 4,542,018), and Strazzolini et al. (U.S. Patent No. 4,594,187).

The Examiner asserts that Sawai discloses purification of teicoplanin using an adsorbent-type resin, which is a porous nonionic styrene-divinylbenzene copolymer. However, the Examiner acknowledges that Sawai “does not teach the purification of teicoplanin A2 by combining an adsorbent resin chromatographic steps with subsequent chromatography steps on

an exchange resin and reversed phase HPLC with the claimed solvent systems.” Therefore, the Examiner relies upon the other references to disclose purification of antibiotics using other purification systems. For example, the Examiner asserts that Restelli discloses that glycopeptides-type antibiotics may be separated from fermentate salts through a non-inorganic macroreticular cross-linked resin (such as Amberlite XAD-7) and then eluted with aqueous acetone (*see* page 6 of the outstanding Office Action).

Yet, the Examiner admits that Sawai does not suggest combining adsorbent resin with additional chromatography steps. The Examiner points to the recent *KSR* decision to support her assertion that it would be “obvious to try” to combine the teachings of these publications. Applicants note, however, that *KSR* supports the “obvious to try” standards in cases where “there is [a] design need or market pressure to solve a problem, and there are finite number of identified, predictable solutions.” *KSR International*, 127 S. Ct. 1727, 1742 (2007). In this instance, there is not a finite number of identified, predictable solutions because an antibiotic may be purified by virtually an infinite number of methods.

In addition, the Examiner points to sections of the *KSR* decision that support the “obvious to try” standard where a patent “simply arranges old element with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement.” *KSR International*, 127 S. Ct. at 1740. Applicants note, however, that the claimed invention produces a unexpected and synergistic result, yielding a higher level of purity than is seen in the prior art, without using excessive amounts of organic solvents. For at least these reasons, Applicant submit that it would not be “obvious to try” to combine the teachings of the cited publications.

For at least the foregoing reasons, Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness. Furthermore, Applicants note that the Examiner suggested, during the November 8th interview, that she would be amenable to arguments establishing that the claimed invention yields unexpected results. In response, Applicants note that the purity obtained using the claimed invention far surpasses that observed in the art, and without use of excess amounts of organic solvent. For example, the claimed invention results in a significantly higher yield and purity than that observed in the art. The claimed invention achieves over 95% purity without the use of an excessive amount of organic solvents (*see, e.g.*, paragraph [0081] of the specification). In contrast, conventional purification methods have obtained teicoplanin A2 with a purity of 85% (*see, e.g.*, paragraph [0013] of the present specification). Based on the results from known methods of purifying teicoplanin (*see, e.g.*, paragraphs [0005] through [0018] of the specification, including a discussion of U.S. Patent No. 4,845,194, which was cited by the Examiner), one skilled in the art would not expect the level of purity and yield obtained with the present invention without the use of organic solvents. Applicants respectfully submit that the claimed invention far surpasses known methods of purification with regard to purity and yield, without use of large amounts of organic solvents, and this result is truly unexpected.

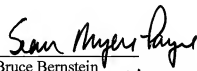
Thus, Applicants assert that the claimed invention achieves results that surpass the expectations of those skilled in the art. Therefore, Applicants submit that the claimed invention has unexpectedly good results, thereby rebutting any *prima facie* case for obviousness the Examiner may have made.

For at least these reasons, Applicants submit that the applied references (singularly or in combination) do not disclose or render obvious all of the elements of the claimed invention.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 19-0089.

Respectfully submitted,
KANG et al.


Bruce Bernstein
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PRODUCT SPECIFICATION INDEX

The following index provides page numbers in the attached SAMYANG product specification, where descriptions of SAMYANG trademarked resins (recited in the specification) may be found.

Trademarked Resins	Description may be found at:
DIAION SP700, DIAION SP825, DIAION SP850	p. 15
DIAION SP207	p. 15
DIAION HP2MG	p. 15
DIAION SK1B	p. 4
DIAION PK216	p. 5
TRILITE SPC 160H, TRILITE SPC 180H	p. 9
DIAION CR11, DIAION CR20	p. 10

[English translation]

Samyang Corporation

November 13, 2007

Samyang Docu. No.: 27110002

FROM: Ion Resin Sales Team, Samyang Corporation

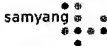
TO: CKD Bio Corp.

C.C: Yoon-Beom HAM, Process Laboratory

Re: Issuance history of Catalogue of Ion Exchange Resin Product

1. We wish you corporation's prosperity.
2. We hereby certify that the enclosed catalogue of Ion Exchange Resin Product is the First English Edition issued on June 16, 1999.

263 Yeonji-dong, Jongno-gu, Seoul, Korea
Samyang Corporation
President: KIM, Yoon



Samyang Corporation

263 Yeong-dong, Chongno-gu, Seoul, Korea
Tel : (02) 40-7732 ~7, Fax : (02) 40-7709

2007 년 11 월 13 일

상양본말 : 제27110002호
발신 : ㈜삼양사 이온수지판매팀
수신 : 종근당바이오 중앙연구소
참조: 공정연구실 황윤범님

제목 : 이온교환수지 제품카다로그 책자발행 연혁

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2. 상기 이온교환수지 제품카다로그는 최초 1999년 6월 16일 영문으로 초판인쇄 발행된 것임이 틀림없음을 확인 드리는 바입니다.

-끝-

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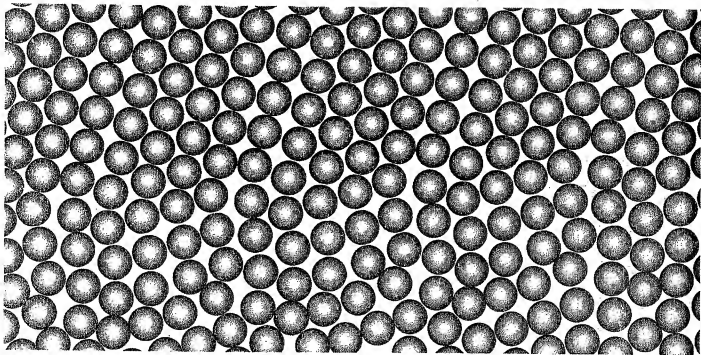
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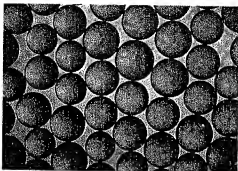
ION EXCHANGE RESIN

DIAION®

PRODUCT LIST



SAMYANG CORPORATION
<http://www.samyang.co.kr>



Samyang Corp. is the only resin maker in Korea and have technical tie-up with Mitsubishi Chemical Corp. since 1975.

Samyang Corp. is the maker of general resins for water treatment and at the forefront of bringing out new products, improving product quality and service to be remained so.

Ion exchange resins are now being used not only for water treatment as in the past, but in a wide variety of fields including the food industry, medicine, and semiconductor industry.

Resin types, too, have increased beyond the simple cation exchange resins and anion exchange resins to include many other kinds such as chelating resins, synthetic adsorbents and resins for ultra pure water treatment.

Samyang Corp. is making every effort to satisfy customer needs through ongoing research and a full range of customer support services.

Technical Service

- ☐ Performance test for ion exchange resins
- ☐ Development of special purpose resins
- ☐ Research of new applications for existing product
- ☐ Advice provision for water treatment equipment

DIAION®**CONTENTS**

STRONGLY ACIDIC CATION EXCHANGE RESINS	(SK, PK series)	4
STRONGLY BASIC ANION EXCHANGE RESINS	(SA, PA series)	6
WEAKLY ACIDIC & WEAKLY BASIC RESINS	(WK, WA series)	8
SPECIALLY ORDERED RESINS	(SPC series & others)	9
CHELATING RESINS	(CR, Eporous series)	10
HIGH POROUS ION EXCHANGE RESINS	(HPK, HPA series)	11
RESINS FOR ULTRA PURE WATER	(SKN, SAN, SMN)	12
FILTER MEDIA & IRON REMOVAL CHEMICAL	(FEROX, RFC-40)	14
SYNTHETIC ADSORBENTS	(HP, SP series)	15
RESINS FOR CHROMATOGRAPHIC SEPARATION	(UBK Series & others)	16
APPENDIX		17

Strongly Acidic Cation-Exchange Resins (Gel Type)

(SK series)

TYPE	Gel Type						
Grade	DIAION SK102	DIAION SK104	DIAION SK106	DIAION SK1B	DIAION SK110	DIAION SK112	DIAION SK116
Matrix	Polystyrene + DVB(Divinylbenzene)						
Functional group	-SO ₃ ⁻ (Sulfonate)						
Ionic Form	Na ⁺						
Specific Gravity	1.09	1.16	1.23	1.29	1.32	1.37	1.38
Shipping Weight (g/l)	745	780	805	825	845	855	865
Moisture Retention	72~82	57~67	47~57	43~50	35~45	32~42	27~37
Total Capacity (meq/ml)	0.61	1.21	1.61	2.01	2.01	2.11	2.11
Effective Size (mm)	0.40~0.60						
Uniformity Coefficient	1.6 Max						
Particle Size (mm)	0.3~1.2						
Operating Temp. (°C)	120 Max						
Operating pH Range	0~14						
Maximum Swelling (Na ⁺ →H ⁺)	6.0%	8.0%	9.0%	9.0%	7.6%	6.0%	5.6%
DVB%	2%	4%	6%	8%	10%	12%	16%
Remarks	<p>Low ← Standard Crosslinkage(8%) → High</p> <p>High stability for organic solvents, strong acids, strong bases and other reducing agents. The higher the DVB%, the higher the stability against oxidation and exchange capacity per volume but high DVB% can be meant low capacity for regeneration efficiency, organic fouling resistance.</p>						
Applications	<p>DIAION SK1B : a standard-crosslinkage(8%) resin Uses are softening and deionization of water, separation and recovery of metals, refining of chemicals/sugar/dextrose/amino acids, desiccation of organic solvents and catalysts, etc.</p> <p>DIAION SK104 : a low crosslinkage resin, suitable for refining of nucleic acid.</p> <p>DIAION SK110 : a high crosslinked version used in general water treatment and condensate polishing and other applications. High stability against oxidation</p> <p>DIAION SK112 : a high crosslinked version, same uses as DIAION SK110 and some special refining.</p>						

Strongly Acidic Cation Exchange Resins (Porous Type)

(PK series)

TYPE	Porous Type				
Grade	DIAION PK208	DIAION PK212	DIAION PK216	DIAION PK220	DIAION PK228
Matrix	Polystyrene + DVB				
Functional group	-SO ₃ ⁻ (Sulfonate)				
Ionic Form	Na ⁺				
Specific Gravity	1.19	1.25	1.29	1.31	1.35
Shipping Weight (g/l)	745	765	780	790	805
Moisture Retention	58~68	52~58	46~52	41~47	37~43
Total Capacity (meq/ml)	1.21	1.51	1.751	1.91	2.051
Effective Size (mm)	0.40~0.60				
Uniformity Coefficient	1.6 Max				
Particle Size (mm)	0.3~1.2				
Operating Temp (°C)	120 Max				
Operating pH Range	0~14				
Maximum Swelling (Na ⁺ -H ⁺)	9.4%	9.5%	8.0%	7.8%	5.8%
DVB%	4%	6%	8%	10%	14%
Remarks	<div> <div>Low</div> <div>← Standard Crosslinkage(8%) →</div> <div>High</div> </div>				
	<p>The polymer matrix contains a large number of macropores. In comparison to gel type ion exchange resins, the porous type has a faster reaction rate, superior decoloring properties, good resistance to organic contamination, and high swelling and contraction strength. Since the macropores contain moisture, porous type resins have a slightly lower exchange capacity per unit of apparent volume and higher exchange capacity per unit weight than gel type resins of the same linkage. The relationship between crosslinkage and properties is the same as gel type resins.</p>				
Applications	<p>DIAION PK208 : a low crosslinkage resin. Softening and deionization of water. Raw water can travel into macro pores, so it is fit to be used as a catalyst and refining of chemicals, sugar and dextrose, Separation of amino acids. Desiccation of organic solvents. Some other uses.</p> <p>DIAION PK216 : a standard-crosslinked porous type resin. Fit for starch sugar/liquid sugar refining because of excellent organic fouling resistance and decoloring property. Softening and deionization of water. Refining of chemicals, sugar and dextrose, Catalysts. Dehydration of polar solvents.</p> <p>DIAION PK228 : a high crosslinked version. High stability against oxidation. General water treatment and condensate polishing and other applications.</p>				

Strongly Basic Anion Exchange Resins (Gel Type)

(SA series)

TYPE	TYPE I			TYPE II	
Grade	DIAION SA10AP	DIAION SA11A	DIAION SA12A	DIAION SA20AP	DIAION SA21A
Matrix	Polystyrene + DVB			Polystyrene + DVB	
Functional group	$-N^+(CH_3)_3Cl^-$ (Trimethylammonium)			$-N^+(CH_3)_2C_2H_4OH Cl^-$ (Dimethylethanolammonium)	
Ionic Form	Cl ⁻			Cl ⁻	
Specific Gravity	1.11	1.07	1.07	1.13	1.09
Shipping Weight (g/l)	685	650	675	700	650
Moisture Retention	43~47	55~65	48~55	39~44	55~65
Total Capacity (meq/ml)	1.31	0.851	1.31	1.31	0.81
Effective Size (mm)	0.35~0.55			0.35~0.55	
Uniformity Coefficient	1.6 Max			1.6 Max	
Particle Size (mm)	0.3~1.2			0.3~1.2	
Operating Temp (°C)	60 Max(OH form) 80 Max(Cl form)			40 Max(OH form) 60 Max(Cl form)	
Operating pH Range	0~14			0~14	
Maximum Swelling (Cl ⁻ → OH ⁻)	24.0%	34.6%	24.4%	11.5%	18.0%
DVB%	8%	4%	6%	8%	4%
Remarks	Type I have strong basicity. As basicity is strong, leakage is only slight but a little more difficult to regenerate than Type I. Chemically little more stable than Type II.			The basicity is slightly lower than Type I. As basicity is rather weaker than Type I, it is much easier to regenerate but leakage is slightly greater. Chemical stability is slightly poorer than that of Type I.	
Applications	<p>DIAION SA10AP : Type I resin with standard crosslinkage. Popularly used for water treatment. It is used as a mixed bed or primary bed polisher anion.</p> <p>DIAION SA11A : Type I resin with low crosslinkage and is mainly used for special applications such as decolorization of sugar solutions and purification of nucleic acid derivatives.</p> <p>DIAION SA12A : Slightly lower crosslinkage than DIAION SA10AP. Deionization of water. Catalysts. Separation of amino acids. Recovery of metals. Some other uses.</p>			<p>DIAION SA20AP : High capacity. Excellent regeneration efficiency. Deionization of water and recovery of metals. Formalin refining. Some other uses.</p> <p>DIAION SA21A : Type II resin with low crosslinkage. Special applications such as purification of pharmaceuticals and food products.</p>	

Strongly Basic Anion Exchange Resins (Porous Type - Type I)

(PA series)

TYPE	TYPE I					TYPE II				
Grade	DIAION PA306	DIAION PA308	DIAION PA312	DIAION PA316	DIAION PA318	DIAION PA406	DIAION PA408	DIAION PA412	DIAION PA416	DIAION PA418
Matrix	Polystyrene + DVB					Polystyrene + DVB				
Functional group	$-N^+(CH_3)_3Cl^-$ (Trimethylammonium)					$-N^+(CH_3)_2C_2H_4OH Cl^-$ (Dimethylethanolammonium)				
Ionic Form	Cl ⁻					Cl ⁻				
Specific Gravity	1.05	1.06	1.08	1.10	1.10	1.06	1.09	1.11	1.12	1.12
Shipping Weight (g/l)	645	655	670	680	680	655	655	680	690	690
Moisture Retention	66~76	57~67	49~55	44~50	42~48	61~71	54~64	46~52	40~46	38~44
Total Capacity (meq/ml)	0.81	1.01	1.21	1.31	1.31	0.71	0.91	1.11	1.31	1.31
Effective Size (mm)	0.35~0.55					0.35~0.55				
Uniformity Coefficient	1.6 Max					1.6 Max				
Particle Size (mm)	0.3~1.2					0.3~1.2				
Operating Temp (°C)	60 Max(OH form) 80 Max(Cl form)					40 Max(OH form) 60 Max(Cl form)				
Operating pH Range	0~14					0~14				
Maximum Swelling (Cl ⁻ - OH ⁻)	22.8%	23.5%	23.0%	18.7%	19.0%	9.7%	13.8%	13.1%	11.7%	11.1%
DVB%	3%	4%	6%	8%	9%	3%	4%	6%	8%	9%
Remarks	PA grades are based on porous styrene/DVB polymer matrix. Porous type resins have high durability against caustic shock by swelling and shrinkage. The total exchange capacity of PA grades is slightly lower than the gel-type resins of same crosslinkage (due to slightly higher water content). The PA grades are more effective especially when high quality water is required such as when silica has to be removed to a very low level. They are also more effective when the raw water contains organic foulants, and either organic fouling resistance or organic removal is necessary.									
Applications	<p>DIAION PA308 : Type I of porous type resins. Because of great stability against organic fouling, it is used for decolorization of water, refining of liquid sugar and decolorization under the possibility of organic fouling.</p> <p>DIAION PA312 : Used in a condensate polisher and deionization of water. Catalysts. Separation of amino acids. Sugar refining. Decolorization, etc.</p> <p>DIAION PA316 : High treatment capacity of silica, little amount of ion leakage. Used for mixed bed or anion tower.</p>					<p>DIAION PA408 : Type II of porous type resin. Suitable for refining of starch sugar, liquid sugar. Decolorization. Separation of amino acids. Some other uses.</p> <p>DIAION PA412 : Perfect for refining of nucleic acid. Deionization of water. Catalysts. Separation of amino acids. Decolorization, etc.</p> <p>DIAION PA416 : Type II of porous type resin. High regeneration efficiency. Used to treat troublesome waters with organic foulants. Decolorization. Refining of liquid sugar.</p>				

Weakly Acidic & Weakly Basic Resins

(WK, WA series)

TYPE	WEAKLY ACIDIC CATION RESINS			WEAKLY BASIC ANION RESINS				
Grade	DIAION WK10	DIAION WK11	DIAION WK40	DIAION WA10	DIAION WA11	DIAION WA20	DIAION WA21J	DIAION WA30
Matrix	Polymethacrylate + DVB		Polyacrylate + DVB	Polyacrylate + DVB		Polystyrene + DVB		Polystyrene + DVB
Functional group	-COOH (Carboxylic acid)		-COOH	-N ⁺ (CH ₃) ₃ OH ⁻ (Trimethylammonium)		-NH(CH ₃ , CH ₃ , NH ₂) ₂ (Tertiary Amino groups)		-N ⁺ (CH ₃) ₃ OH ⁻ (Trimethylammonium)
Ionic Form	H ⁺			OH ⁻				
Specific Gravity	1.15	1.16	1.20	1.05	1.06	1.07	1.06	1.05
Shipping Weight (g/l)	615	665	805	650	675	650	640	615
Moisture Retention	66 ~ 76	57 ~ 67	43 ~ 50	63 ~ 69	57 ~ 63	39 ~ 45	40 ~ 52	43 ~ 55
Total Capacity (meq/ml)	0.81	1.01	4.41	1.21	1.41	2.51	2.01	1.51
Effective Size (mm)	0.40 ~ 0.60			0.40 ~ 0.60				
Uniformity Coefficient	1.6 Max			1.6 Max				
Particle Size (mm)	0.3 ~ 1.2			0.3 ~ 1.2				
Operating Temp. (°C)	150 Max		120 Max	60 Max(OH form)		100 Max (OH form)		
Operating pH Range	5 ~ 14			0 ~ 9				
Maximum Swelling (H ⁺ - Na ⁺) (OH ⁻ - Cl ⁻)	50.0%	40.0%	50.0%	20.0%	20.0%	30.0%	25.0%	30.0%
Remarks & Applications	<p>DIAION WK10, DIAION WK11 Methacrylic type. Weakly acidic cation exchange resins. WK10 has fast reaction rate, and WK11 has high total exchange capacity. These grades are mainly used for special applications such as purification of foods, pharmaceuticals, organic chemicals.</p> <p>DIAION WK100 High reaction rate and high adsorption capacity. Mainly used for the purification of pharmaceuticals and foods.</p> <p>DIAION WK40 Carboxylic acid functionality based on porous acrylic polymer matrix. Higher total capacity than methacrylic type resins. Water treatment for removal of hardness ions in the presence of bicarbonate alkalinity.</p>			<p>DIAION WA10 Tertiary amine functionality with high regeneration efficiency. The acrylic polymer matrix provides good chemical stability and good resistance to organic fouling. Mainly used for pretreatment of starch hydrolyzates(such as corn syrup) containing minerals at high levels, and purification of dextrose, beet sugar solutions, and formaldehyde.</p> <p>DIAION WA20 ,DIAION WA21J They don't have neutral salt splitting capacity but do have high total exchange capacity and high regeneration efficiency. High chemical stability and high mechanical strength against attrition loss. High chemical stability and high durability against organic fouling. The removal of strong mineral acids in standard water treatment and the treatment of organic solvents. WA21J has excellent mechanical strength, so it is recommended over WA20 for rigorous industrial applications.</p> <p>DIAION WA30 High porous weakly basic anion exchange resin. Due to it's high chemical stability, durability against organic fouling, it is used for removal of organic substances of high molecular weight, denaturation and decolorization of starch hydrolyzates (such as corn syrup, dextrose, HFC's and sugar solutions) and purification of glycerine and enzymes.</p>				

Specially Ordered Resins

(SPC series & Others)

TYPE	CATALYTIC RESINS		INERT RESIN		MIXED RESIN
Grade	TRILITE SPC160H	TRILITE SPC180H	TRILITE TR70	DIAION PS20	TRILITE SM210
Matrix	Polystyrene + DVB		Polyethylene	Polystyrene + DVB	Polystyrene + DVB
Functional group	-SO ₃ ⁻ (Sulfonate)		-		DIAION SK1BH + DIAION SA10APOH
Ionic Form	H ⁺		-		H ⁺ / OH ⁻
Shipping Weight (g/l)	740	725	500	700	700
Moisture Retention	54~60	53~60	-	-	-
Total Capacity (meq/m ³)	1.51	1.51	-	-	0.61 (Water quality : over 10 µs/cm)
Effective Size (mm)	0.40~0.55	0.40~0.55	-	-	0.40~0.60
Uniformity Coefficient	1.5 Max	1.5 Max	-	-	1.6 Max
Particle Size (mm)	0.3~1.2	0.3~1.2	1.2~1.8	0.42~0.84	0.3~1.2
Operating Temp. (°C)	120 Max		90 Max	90 Max	50 Max
Operating pH Range	0~14		-		0~14
Maximum Swelling (Na ⁺ ~ H ⁺)	8.0%	8.0%	-		-
Remarks & Applications	<p>TRILITE SPC160H Strongly acidic cation exchange resin with porous styrene polymer matrix. High whole bead count and low uniformity coefficient. Excellent mechanical strength against attrition loss and high chemical/physical stability. The modified form of DIAION PK216 (treatment for water with high chloride concentration and high temp. water) to be suitable as catalysts for esterification (THF, Tetrahydrofuran) or hydrolysis.</p> <p>TRILITE SPC180H Strongly acidic porous type resin with styrene polymer matrix. Notable is its high porosity and a large specific surface area. Because of high reactivity and high penetration rate to resin interior, it has excellent reaction efficiency. Used for general water treatment such as softening and deionization of water, manufacturing high purity water. Also suitable as catalysts in esterification (1,4BD, 1,4Butanediol) and other special applications.</p>		<p>TRILITE TR70 Inert synthetic resin with no functional groups. Has lighter specific gravity than water (it makes them float at the top of a ion exchange tower) preventing problems from happening at downflow systems. Problems are moving of ion adsorption area, overflow of activated resin particles, diffusion of regenerants, etc. TRILITE TR70 prevents all of above from happening.</p> <p>DIAION PS20 No functional groups. Polystyrene/DVB matrix. Due to its medium specific gravity between strongly acidic cation exchange resin and strongly basic anion exchange resin, it forms the boundary between the two resins in a mixed bed. DIAION PS20 helps separation of the two resins and prevents bad regeneration in a mixed bed.</p>		<p>TRILITE SM210 Manufactured by mixing DIAION SK1BH and DIAION SA10APOH at the ratio of total capacity. Exchanging cation and anion ions continuously, so high purity water can be easily obtained. SM210 is widely used to get high purity water. Also used for wire-cutting polisher, polisher for R/O unit and other polishers. Widely used in many industries because TRILITE SM210 makes it easy to get high purity water.</p>

Chelating Resins

(CR, Eporous series)

TYPE	CR series			Eporous series		
Grade	DIAION CR11	DIAION CR20	DIAION CRB02	Eporous MX-8C	Eporous Z-7	Eporous K-1(3)
Matrix	Polystyrene + DVB			Polystyrene + DVB		
Functional group	$\text{-CH}_2\text{N}^+\text{K}^+\text{CH}_2\text{COO}^-\text{Na}^+\text{CH}_2\text{COO}^-\text{Na}^+$ Iminoacetate	$\text{-CH}_2\text{NH}(\text{C}_2\text{H}_4\text{NH})_2\text{H}$ Polyamine	$\text{-(CH}_2)_4\text{OHCH}_2\text{OH}$ Glucamine	Imino Group + Carboxylic Acid	Imino Group + Carboxylic Acid	Imino Group + Carboxylic Acid
Ionic Form	Na^+	OH^-	OH^-	Ca^{2+}	Na^+	$\text{AP}^+(\text{Na}^+)$
Shipping Weight (g/l)	730	685	635	788	810	780(725)
Moisture Retention	55 ~ 65	50 ~ 60	50 ~ 60	35 ~ 55	35 ~ 50	40 ~ 60 (35 ~ 55)
Total Capacity	Cu^{2+} 0.51 (pH4.5, mmol/m ²) Ca^{2+} 0.351 (meq/m ²)	Cu^{2+} 0.41 (pH4.0, mmol/m ²)	Acid 0.61 (meq/m ²)	0.6mol Cd^{2+} /l - Resin	550 ~ 650g Hg/l - Resin	11g F^- /l - Resin (130g BF_4^- /l - R)
Effective Size (mm)	0.401			0.501	0.501	0.501 (0.501)
Uniformity Coefficient	1.6 Max			-		
Particle Size (mm)	0.3 ~ 1.2			0.3 ~ 2.0		
Operating Temp. (°C)	80 Max(H form) 120 Max(Na form)	100 Max (OH form)	100 Max (OH form)	100 Max		
Operating pH Range	Approx. 1 ~ 5	Approx. 4 ~ 6	5 ~ 10	4 ~ 7	1 ~ 8	5 ~ 7(4 ~ 8)
Maximum Swelling	30.0% (H ⁺ - Na ⁺)	6.0% (OH ⁻ - Zn ²⁺)	-	Almost none	Almost none	Almost none
Remarks & Applications	<p>DIAION CR11 High porous styrenic matrix. Rapid kinetics, high operating capacity, low swell/shrink ratio and excellent mechanical stability. Captures metal ions by chelation with its iminoacetate functionality. Higher selectivity (than strongly and weakly acidic cation exchange resins) for divalent ions, like Cu, Fe, etc. Because of its high selectivity, it can be used for separation of divalent from monovalent ions, treatment of salty water in the making of NaOH and wastewater treatment.</p> <p>DIAION CR20 Special resin with polyamine functionality. High porous styrene/DVB matrix. High selectivity to heavy metal ions but it does not absorb alkali metal, alkali earth metal ions therefore, it can be used for heavy metal recovery from alkali metal or alkali earth metal ion solutions.</p> <p>DIAION CRB02 Special chelating resin with glucamine groups based on High porous styrene/DVB matrix. High selectivity to borate ion. It is used for borate separation from various solutions, including brines and sea water.</p>			<p>Eporous MX8C High selectivity for various metal ions. Used for the waste water treatment containing the heavy metal ions, the metal recovery and many other applications.</p> <p>Eporous Z-7 Effectively adsorb Hg in a wide range of pH. Eporous Z-7 can remove Hg below 0.1 ppb. Waste water treatment and other special applications.</p> <p>Eporous K-1 Specially developed for the adsorb of F⁻. Effectively remove F⁻ even at the low concentration. It has high regeneration efficiency.</p> <p>Eporous K-3 Specially developed for the adsorb of BF₄⁻. Effectively remove BF₄⁻ even at the low concentration. High regeneration efficiency.</p> <p>Eporous K-6 High chemical stability. Chelating resin for the absorption of Cr.</p>		

High Porous Ion Exchange Resins

(HPK, HPA series)

TYPE	HPK series	HPA series TYPE I	HPA series TYPE II
Grade	DIAION HPK25	DIAION HPA25	DIAION HPA75
Matrix	Polystyrene + DVB	Polystyrene + DVB	
Functional group	-SO ₃ ⁻ (Sulfonate)	-N ⁺ (CH ₃) ₃ Cl ⁻ (Trimethylammonium)	-N ⁺ (CH ₃) ₂ C ₂ H ₄ OH Cl ⁻ (Dimethylethanolammonium)
Ionic Form	Na ⁺	Cl ⁻	
Shipping Weight (g/l)	790	625	625
Moisture Retention	37 ~ 47	56 ~ 68	56 ~ 66
Total Capacity (meq/ml)	1.71	0.51	0.51
Effective Size (mm)	0.401	0.251	
Uniformity Coefficient	1.6 Max	1.6 Max	
Particle Size (mm)	0.3 ~ 1.2	0.3 ~ 1.2 (Over 0.25, 90%)	
Operating Temp. (°C)	120 Max	50 Max(OH form) 80 Max (Cl form)	40 Max(OH form) 60 Max (Cl form)
Operating pH Range	0 ~ 14	0 ~ 14	
Remarks & Applications	DIAION HPK25 High porous strongly acidic ion exchange resin. Due to its very high porosity, it has a large specific surface area and pore volume. Therefore, it is useful for the treatment of non-polar solvents and adsorption of large counter ions which cannot diffuse in the micropores. Catalytic reaction and some other special applications. Also can be used in strong oxidative solvents.	DIAION HPA25, HPA75 High porous strongly basic ion exchange resins. Have much higher crosslinkage than gel type or normal porous type. High pore volume and a large specific surface area. DIAION HPA25 is a type I resin and DIAION HPA75 is a type II resin. The general tendency is almost the same as gel, porous type resins. Suitable for the adsorption of large counter ions. Refining of enzymes, removal of chromaticity, ion exchange in non-polar solvents, treatment of pulp waste water, and decolorization of sugar solutions.	

Resins for Ultra Pure Water

(SKN, SAN, SMN series)

TYPE	STRONGLY ACIDIC CATION ION EXCHANGE RESINS			
Grade	DIAION SKT10	DIAION SKNUP	DIAION PKT228L	DIAION PK228LU
Appearance	Brown translucent beads (Gel Type)		Whitish-brown opaque beads (Porous Type)	
Matrix	Polystyrene + DVB			
Functional group	-SO ₃ ⁻ (Sulfonate)			
Ionic Form	H ⁺			
Ionic Form Conversion Rate (eq%)	H form 99.9% Min	H form 99.0% Min	H form 99.9% Min	H form 99.0% Min
Total Capacity (meq/m ²)	1.7l	1.7l	1.9l	1.9l
Moisture Retention	50~60	50~60	39~49	39~49
Effective Size (mm)	0.40l		0.45l	
Uniformity Coefficient	1.5 Max			
Particle Size (mm)	0.300~1.180 Over 1.180, 0.5% Under 0.300, 1%		0.425~1.180 Over 1.180, 5% Under 0.425, 1%	
Operating Temp. (°C)	120 Max			
Operating pH Range	0~14			
Water quality test results				
Condition(1) [Flow raw water (specific resistance≥15 MΩ·cm) at the rate of SV30] ● outlet resistivity(MΩ·cm) ● outlet ΔTOC(ppb)	Less than 3hr, 12 Min Less than 3hr, 20Max		Less than 3hr, 12 Min Less than 3hr, 50Max	
Condition(2) SKNUP : Mixed with SANUP at the T/C ratio of 1:1 PKT228L : Mixed with PAT312L at the T/C ratio of 1:1 PK228LU : Mixed with PAS12LUP at the T/C ratio of 1:1 (2)-1 [Flow raw water (specific resistance≥15 MΩ·cm) at the rate of SV13] ● outlet resistivity(MΩ·cm) (2)-2 [Flow raw water (specific resistance≥15 MΩ·cm) at the rate of SV30] ● outlet resistivity(MΩ·cm) ● outlet ΔTOC(ppb)	Less than 30min, 15 Min		Less than 30min 15 Min	
			Less than 3hr, 18 Min Less than 3hr, 20Max	

※ T/C : Total Capacity

Resins for Ultra Pure Water

(SKN, SAN, SMN series)

TYPE	STRONGLY BASIC ANION ION EXCHANGE RESINS			
Grade	DIAION SAT10	DIAION SANUP	DIAION PAT312L	DIAION PA312LUP
Appearance	Light yellow translucent beads (Gel Type)		Yellowish-white opaque beads (Porous Type)	
Matrix	Polystyrene + DVB			
Functional group	-N ⁺ (CH ₃) ₃ Cl ⁻ (Trimethylammonium)			
Ionic Form	OH ⁻			
Ionic Form Conversion Rate (eq%)	OH form : 90.0% ¹ , Cl form : 1% ¹			
Total Capacity (meq/m ²)	0.9 ¹	0.9 ¹	0.9 ¹	10.9 ¹
Moisture Retention	55 ~ 65	55 ~ 65	58 ~ 68	58 ~ 68
Effective Size (mm)	0.40 ¹		0.45 ¹	
Uniformity Coefficient	1.6 Max			
Particle Size (mm)	0.300 ~ 1.180 Over 1.180, 5% ¹ Under 0.300, 1% ¹		0.425 ~ 1.180 Over 1.180, 5% ¹ Under 0.425, 5% ¹	
Operating Temp. (°C)	60 Max			
Operating pH Range	0 ~ 14			
Water quality test results				
Condition(1) [Flow raw water (specific resistance ≥ 15 MΩ · cm) at the rate of SV30] ● outlet resistivity(MΩ · cm) ● outlet ΔTOC(ppb)				
Condition(2) SANUP : Mixed with SKNUP at the T/C ratio of 1:1 PAT312L : Mixed with PKT228L at the T/C ratio of 1:1 PA312LUP : Mixed with PK228LU at the T/C ratio of 1:1 (2)-1 [Flow raw water (specific resistance ≥ 15 MΩ · cm) at the rate of SV13] ● outlet resistivity(MΩ · cm) (2)-2 [Flow raw water (specific resistance ≥ 15 MΩ · cm) at the rate of SV30] ● outlet resistivity(MΩ · cm) ● outlet ΔTOC(ppb)				

Resins for Ultra Pure Water

(SKN, SAN, SMN series)




TYPE	MIXED RESIN		
Grade	DIAION SMT100	DIAION SMNUPB	DIAION SMNUP
Component Resins	Mix SKT10 & SAT10 at the T/C ratio of 1:1	Mix SKNUP & SANUP At the T/C ratio of 1:1	
Water quality test results			
1. Flow raw water (specific resistance $\geq 15 \mu\Omega \cdot \text{cm}$) at the rate of SV13 ● outlet resistivity ($\mu\Omega \cdot \text{cm}$)		Less than 5min, 15 Min Less than 30min, 17.5Max	Less than 30min, 15 Min
2. Flow raw water (specific resistance $\geq 15 \mu\Omega \cdot \text{cm}$) at the rate of SV30 ● outlet resistivity ($\mu\Omega \cdot \text{cm}$) ● outlet ΔTOC (ppb)	Less than 3hr, 18 Min Less than 3hr, 10 Max		

Filter Media & Iron Removal Chemical

(FEROX, RFC-40)

TYPE	FILTER MEDIA FOR ION & MANGANESE REMOVAL
Grade	FEROX
Matrix	Chamotte
Specific Gravity	2.4
Particle Size (mm)	Large 2.5~5.0 Medium 1.0~2.5 Small 0.5~1.6
Uniformity Coefficient	1.7 Max
Applications	Filter media which has high degree of iron and manganese removing capacity (1.5g Fe/£). No need of chemicals for a equipment. Long life cycle.

TYPE	IRON REMOVAL CHEMICAL FOR ION EXCHANGE RESINS
Grade	RFC-40
Appearance	White Powder
Ingredients	NaCl Over 90% Sodium Succinate Under 3% Sodium Citrate Under 3% Sodium Phosphate Under 3%
Applications	Cation exchange resin used for softening hard water gradually loses its capacity to soften water because of the adhesion of iron contained in raw water on the resin. RFC-40 will remove iron and regenerate cation exchange resin.

TYPE	Styrene Type				Chemically Modified Styrene Type	Methacrylic Type
Grade	DIAION HP20	SEPABEADS SP625	SEPABEADS SP650	SEPABEADS SP700	SEPABEADS SP207	DIAION HP2MG
Chemical Structure						
Shipping Weight (g/l)	680	690	670	680	780	720
Moisture Retention	55~65	52~62	46~52	60~70	43~53	55~65
Effective Size (mm)	0.25]					0.35]
Uniformity Coefficient	1.6 Max					1.6 Max
Particle Size (mm)	Over 0.25, 90%]					Over 0.30, 90%]
Specific Surface Area (m ² /g) ※	600	1,000	1,000	1,200	630	470
Pore Volume (ml/g) ※※	1.3	1.4	1.2	2.3	1.3	1.2
Pore Radius (Å) ※※	200~300	50~60	35~45	85~95	105	170
Remarks & Applications	<p>DIAION HP20, HP21 High porous, styrenic adsorption resins. They have relatively large pore size and are suitable for adsorption of large molecules. Also elute adsorbed solutes easily with common organic solvents, acids and bases. Widely used in a variety of industry applications, especially adsorption, desalting, decolorization, and refining of protein/antibiotics (ex. Cepha-C)</p> <p>DIAION SP625, SP650 Have much larger surface area and a narrower, more uniform pore size distribution than the HP20 grades. They offer nearly two times the surface area of HP20, or twice the capacity for small molecules (<1,500mw). These grades are recommended for adsorption, desalting, and decolorization.</p> <p>DIAION SP700 Newly developed product. Has the biggest pore volume/radius and specific surface area. Excellent adsorption & elution ability. Refining of pharmaceuticals/food, desalting, and decolorization, etc.</p> <p>DIAION SP207 SP207 has bromine groups chemically bonded to the crosslinked polystyrene matrix. It has higher hydrophobicity (greater selectivity for non-polar molecules) than pure styrenic polymers. It has about 1.2 times higher specific gravity than other styrenic adsorbents. Applied in upflow fluidized bed contact(EBA) applications.</p> <p>DIAION HP2MG A high porous, methacrylate based adsorption resin. It does not contain any aromatic compounds. It is considered an intermediate polarity adsorption resin. It is suitable for desalting and adsorption of organic compounds of relatively high polarity by using the more hydrophilic characteristics of the polymer matrix.</p>					

※B.E.T ※※Mercury Intrusion

Resins for Chromatographic Separation

(UBK series & Others)

TYPE	UBK Series			HP, SP20SS	
Grade	DIAION UBK530	DIAION UBK550	DIAION UBK555	DIAION HP20SS	SEPABEADS SP20SS
Matrix	Polystyrene + DVB			Polystyrene + DVB	
Functional group	-SO ₃ ⁻ (Sulfonate)			-	
Ionic Form	Na ⁺	Na ⁺	Ca ²⁺	-	
Shipping Weight (g/l)	810	825	855	680	680
Moisture Retention	52.0~55.5	46.0~49.5	42.0~46.0	55~65	55~65
Total Capacity (meq/ml)	1.6l	1.9l	2.0l	-	
Particle Size (mm)	0.200~0.240 85%l		0.190~0.240 85%l	Over 0.150, 15%l 0.150~0.063, 70%l Under 0.063, 20%l	Over 0.075, 35%l 0.075~0.063, 50%l Under 0.063, 15%l
Remarks & Applications	<p>DIAION UBK Series Chromatographic separation technology has been widely used at large industrial scale for separation and purification of various products in the pharmaceutical, fermentation and food industries. In these processes, resins of smaller particles and sharper particle distribution allow processes with higher purity, better recovery and greater yield. It has uniform particle size (200 ~ 240 μm) with excellent kinetics and mechanical stability. Applied in simulated moving bed (SMB) equipment for large scale chromatographic separation of important industrial molecules, such as fructose/glucose separation and sucrose recovery from molasses.</p> <p>DIAION HP20SS, SEPABEADS SP20SS Smaller size resins are required to obtain higher purity and better recovery in chromatographic separation of pharmaceuticals using synthetic adsorbents. HP20SS has a particle size distribution of 75~150 μm and offers a nice balance of pressure flow characteristics and true chromatographic fractionation. HP20SS has been applied in SMB applications for a variety of small biomolecules. SP20SS is a product of even smaller particle size distribution and sharper distribution. It is often applied as a process scale support for reversed phase chromatography in either the isocratic or gradient mode. It offers a better separation efficiency than HP20SS and often competes with bonded silica based supports for preparative and industrial applications.</p>				

NOMENCLATURE OF DIAION

① PREFIX

- **SK Series** : S(Strong), K(Cation)
- **SA Series** : S(Strong), A(Anion)
- **WK Series** : W(Weak), K(Cation)
- **WA Series** : W(Weak), A(Anion)
- **PK Series** : P(Porous), K(Cation)
- **PA Series** : P(Porous), A(Anion)

② SUFFIX

- **P** : PSA(Polystyrene Sulfonic Acid, Anti-static electricity agent) has been added at the end of the manufacturing process
(Ex. SA10AP, SA20AP, ...)
- **L** : Large, Particle size of general resin is 0.3 ~ 1.2 mm, but L-Type is 0.425 ~ 1.2 mm
(Ex. SK1BL, SA20APL, PK228L, ...)
- **H; OH** : Ionic form (H form, OH form)
(Ex. SK1BH, SA10APOH, ...)

CAUTIONS ON USAGE OF ION EXCHANGE RESINS

① Handling

Protective equipment is needed to protect eyes and skin and handle resins in areas with good ventilation. Eye-wash facilities are recommended at the using area. When resins are spilled on the floor, they are very slippery and may cause a person to fall. Avoid exposure to high temperature, sparks, flames, etc. Also avoid contact or mixing with oxidizing agents such as nitric acid because it is known that ion exchange resins can explode on contact with nitric acid.

② Storage

Resins should be stored in a dry, cool and dark places with good ventilation. The storage container, bag or fiber drum should be tightly to prevent intrusion of impurities and drying.

Do not store resins with oxidizing agents in the same place. At high temperature, rapid degradation of resins may occur, and below 0°C, freezing of resins may occur. The freezing of resins may cause physical breakage and low whole bead content.

③ Disposal

Unused resins may be discarded by landfill or incineration following local regulations and the cautions mentioned above.

A suitable fitted furnace is necessary for incineration because SO_x , NO_x , CO_x , etc. will be generated from incineration.

Used resins may also be land-filled or incinerated as long as they contain no toxic or poisonous material such as heavy metals. Resin can only be discarded, as above, after removal of poisonous material.

PRETREATMENT OF ION EXCHANGE & ADSORBENT RESINS

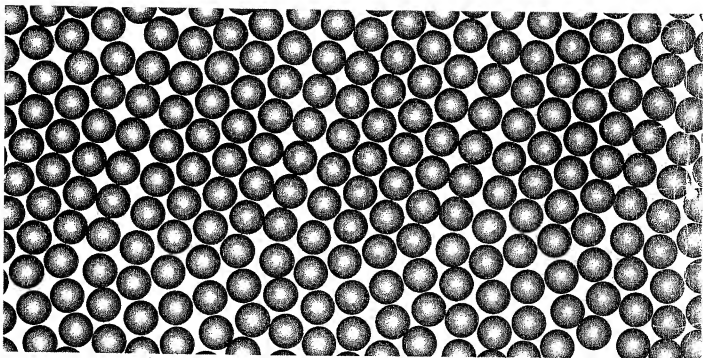
Ion exchange resins should be conditioned and prepared prior to initial usage. It is typically recommended to backwash the resin bed after charging to the vessel in order to remove any resin fines (50 mesh particles) and small particles.

The conditioning treatments will vary depending on column design and available chemicals, and the ionic form required for the initial loading or service cycle. Washing with 4-8% HCl and 4% NaOH alternatively, and washing with the regenerant chemical and rinsing water alternatively, are popular pretreatment methods. The method and the number of the pretreated cycles are different depending on the required quality of water. Sometimes an increased number of cycle is necessary to reduce leaked materials (when influence of elution from resins is large).

A number of DIAION ion exchange resins and synthetic adsorbent resins can be applied in secondary direct food application. Special conditioning methods (that are specific to each grade) must be applied to the new resins prior to initial usage.

TABLE OF EQUIVALENTS

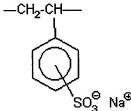
DIAION	AMBERLITE	DUOLITE	DOWEX	KASTEL	LEWATT	PUROLITE	IONAC	IMAC
STRONGLY ACIDIC CATION EXCHANGE RESINS (GEL TYPE)								
SK1B	IR120	C20	HCRS	C300	S108	C100	C248	C12
SK1BH	IR120H	C20H	HCRW2			C100(H)	C267	
SK1BL	IR120RF				S100WS		C288C	
SK102								
SK104								
SK105	IR118	C206A		C322	S109	C120E	CFA	
SK110	IR122	C255	HGRW2	C235	ST15	C100x 10	CS399N+	C14
SK112								
SK114								
SK116								
STRONGLY ACIDIC CATION EXCHANGE RESINS (POROUS TYPE)								
PK208								
PK212					SP120			
PK216								
PK220	252	C26	88	C300P	SP112	C150		C8P
PK228	206	C264	MSC1		SP114		CFP110	C16P
STRONGLY BASIC ANION EXCHANGE RESINS (GEL TYPE, TYPE I)								
SA10AP	IRA420	A113	SBP P	A500	M500	A400	ASB1	
SA11A	IRA401S	A147		A501D	M500Z		A34	
SA12A	IRA402					A600	ASB1 P	SS-40
STRONGLY BASIC ANION EXCHANGE RESINS (GEL TYPE, TYPE II)								
SA20AP	IRA416	A116	SAR	A300	M600	A200	ASB2	SS-42
SA21A								
STRONGLY BASIC ANION EXCHANGE RESINS (POROUS TYPE, TYPE I)								
PA306								
PA308	IRA901	A171	11	A501P	MP500A		A642	250
PA312	IRA908	A161	MSA1	A500P		A500	A641	SS-90
PA316								
PA318								
STRONGLY BASIC ANION EXCHANGE RESINS (POROUS TYPE, TYPE II)								
PA406								
PA408	IRA958	A173			AP247A			A31
PA412	IRA910	A162	MSA2	A300P	MP600	A510	A651	A32
PA416								
PA418								
WEAKLY ACIDIC CATION EXCHANGE RESINS (METHACRYLIC TYPE)								
WK10	IRC60	C462	MWC2			C106	CNN	
WK11		C464						
WEAKLY ACIDIC CATION EXCHANGE RESINS (ACRYLIC TYPE)								
WK40	IRC86	C433	CCR2	C100	CNP80	C105	CC	Z5
WEAKLY BASIC ANION EXCHANGE RESINS (ACRYLIC TYPE)								
WA10								
WA11	IRA67	A375			AP49		A28	
WEAKLY BASIC ANION EXCHANGE RESINS (STYRENE TYPE)								
WA20								
WA21		A368S	66		MP62	A103	AFP329	A24
WA30	IRA63SP	A378	MWA1	A101	MP64	A100	A328	A20S
CHELATING RESINS								
CR11	IRC718	C467			TP207			
Eporous Z-7					TP214	360	SR5	
RESINS FOR ULTRA PURE WATER								
SK210	M9604				SM92	M5400		
SK2UP	IRN77	ARC9351			OC1213	NRW100	NC10	
SM2UP	IRN78	ARA9366			OC1243	NRW450	NA38	
SM2UP	IRN150	ARM9381	MR3		OC1253	NRW39	NM60	
		ARM9281D				NRW37		
						NRW37IND	NM65	
SK10								
SA110								
SMT100								
INERT RESINS								
TR70	RF14		XZ96270		IN42	IP4		
PS20	AMBERMBE359					IP5		
SYNTHETIC ADSORBENTS								
HP20	AX1204							
SP625	XAD1600T							
SP850								



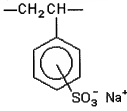
SAMYANG CORPORATION

263 Yeonji-dong, Chongno-gu, Seoul, Korea
TEL : 82-2-740-7732-8
FAX : 82-2-740-7709

DIAION® cation-exchange resins**● DIAION® SK series (Gel type)**

Product	DIAION SK1B	DIAION SK104	DIAION SK110	DIAION SK112	DIAION SK116
Chemical structure					
Ionic form	Na				
Appearance index	> 90				
Apparent density (g/L-R)	825	780	845	855	865
Ion-exchange capacity (meq/mL)	> 2.0	> 1.2	> 2.0	> 2.1	> 2.3
Water content (%)	43-50	57-67	35-45	32-42	27-37
Particle size distribution > 1180 μm < 300 μm	< 5 % < 1 %				
Effective size (mm)	> 0.40				
Uniformity coefficient	< 1.6				
Maximum temperature (°C)	120 (H form, Na form)				
Crosslinkage (%)	8	4	10	12	16

● DIAION® PK series (Porous type)

Product	DIAION PK208	DIAION PK212	DIAION PK216	DIAION PK220	DIAION PK228
Chemical structure					
Ionic form	Na				
Appearance index	> 90				

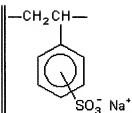
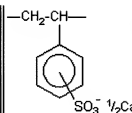
Apparent density (g/L-R)	745	765	780	790	805
Ion-exchange capacity (meq/mL)	> 1.2	> 1.5	> 1.75	> 1.9	> 2.05
Water content (%)	58-68	52-58	46-52	41-47	37-43
Particle size distribution > 1180 μm < 300 μm	< 5 % < 1 %				
Effective size (mm)	> 0.40				
Uniformity coefficient	< 1.6				
Maximum temperature (°C)	120 (H form, Na form)				
Crosslinkage (%)	4	6	8	10	14

● DIAION® WK series

Product	DIAION WK10	DIAION WK11	DIAION WK100	DIAION WT01S	DIAION WK40
Chemical structure	$\begin{array}{c} \text{CH}_3 \\ \\ -\text{CH}_2-\text{C}- \\ \\ \text{COOH} \end{array}$				$\begin{array}{c} -\text{CH}_2-\text{CH}- \\ \\ \text{COOH} \end{array}$
Appearance index	> 95			> 90	> 95
Apparent density (g/L-R)	615	665	670	765	805
Ion-exchange capacity (meq/mL)	> 2.5	> 2.9	> 2.8	> 3.0	> 4.4
Water content (%)	53-59	45-52	45-55	45-55	43-50
Particle size distribution > 1180 μm < 300 μm	< 5 % < 1 %			300 ~106 μm > 85 %	< 10 % < 1 %
Effective size (mm)	> 0.40			0.10?0.14	> 0.40
Uniformity coefficient	< 1.6				< 1.7
Maximum temperature (°C)	< 150				< 120

● DIAION® UBK series

Product	DIAION UBK530	DIAION UBK550	DIAION UBK535	DIAION UBK555
Chemical structure				

			
Ionic form	Na	Ca	
Appearance index	> 95		
Apparent density (g/L-R)	810	825	855
Ion-exchange capacity (meq/mL)	> 1.6	> 1.9	> 2.0
Water content (%)	52.0-55.0	46.0-49.5	42.0-46.0
Particle size distribution	200-240 μm > 85 %		190-240 μm > 85 %



For questions and comments, please click [here](#).
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**AMBERLYST® 131WET**

Industrial Grade Strongly Acidic Catalyst

PRODUCT DATA SHEET

AMBERLYST 131WET is an improved solid acid polymeric catalyst* with a uniform particle size. AMBERLYST 131WET is highly active for condensation reactions such as the condensation of phenol with acetone to produce Bisphenol-A. This catalyst* is specially designed to produce BPA of unsurpassed color and purity.

AMBERLYST 131WET's particle size and pore structure allow for reduced reactor pressure drop and significantly higher productivity than conventional ion exchange resin catalysts.

PROPERTIES

Physical form	Light brown spherical beads
Ionic form as shipped	Hydrogen
Concentration of acid sites ^[1]	≥ 4.8 eq/kg
Moisture holding capacity ^[1]	62 to 68 % (H ⁺ form)
Shipping weight	740 g/L (46 lbs/ft ³)
Particle size	
Harmonic mean size	0.700 - 0.800 mm
Uniformity coefficient	≤ 1.15
Fines content ^[1]	< 0.425 mm : 0.5 % max
Coarse beads	> 1.180 mm : 2.0 % max

^[1] Contractual value

Test methods are available on request.

SUGGESTED OPERATING CONDITIONS

Maximum operating temperature	130°C (265 °F)
Minimum bed depth	60 cm (24 inches)
Operating flow rate	1 to 5 BV**/h (LHSV)
Pressure drop limitation	1 bar (15 psig) across the bed

* U.S. Patent 5,233,096 to the Rohm and Haas Company, August 1993.

** 1 BV = 1 m³ solution per m² of resin

All our products are produced in ISO 9002 certified manufacturing facilities.

Rohm and Haas/Ion Exchange Resins - Philadelphia, PA - Tel. (800) RH AMBER - Fax: (215) 537-4157
Rohm and Haas/Ion Exchange Resins - 75579 Paris Cedex 12 - Tel. (33) 1 40 02 50 00 - Fax : 1 43 45 28 19

WEB SITE: <http://www.rohmhaas.com/ionexchange>



AMBERLYST is a trademark of Rohm and Haas Company, Philadelphia, U.S.A.

Ion exchange resins and polymeric adsorbents, as produced, contain by-products resulting from the manufacturing process. The user must determine the extent to which organic by-products must be removed for any particular use and establish techniques to assure that the appropriate level of purity is achieved for that use. The user must ensure compliance with all prudent safety standards and regulatory requirements governing the application. Except where specifically otherwise stated, Rohm and Haas Company does not recommend its ion exchange resins or polymeric adsorbents, as supplied, as being suitable or appropriately pure for any particular use. Consult your Rohm and Haas technical representative for further information. Acidic and basic regenerant solutions are corrosive and should be handled in a manner that will prevent eye and skin contact. Nitric acid and other strong oxidizing agents can cause explosive type reactions when mixed with Ion Exchange resins. Proper design of process equipment to prevent rapid buildup of pressure is necessary if use of an oxidizing agent such as nitric acid is contemplated. Before using strong oxidizing agents in contact with Ion Exchange Resins, consult sources knowledgeable in the handling of these materials.

Rohm and Haas Company makes no warranties either expressed or implied as to the accuracy or appropriateness of this data and expressly excludes any liability upon Rohm and Haas arising out of its use. We recommend that the prospective users determine for themselves the suitability of Rohm and Haas materials and suggestions for any use prior to their adoption. Suggestions for uses of our products of the inclusion of descriptive material from patents and the citation of specific patents in this publication should not be understood as recommending the use of our products in violation of any patent or as permission or license to use any patents of the Rohm and Haas Company. Material Safety Data Sheets outlining the hazards and handling methods for our products are available on request.

**AMBERLYST® 232WET**

Industrial Grade Strongly Acidic Catalyst

PRELIMINARY PRODUCT DATA SHEET

AMBERLYST 232WET is a gel type, sulphonic acid polymeric catalyst with a uniform particle size. AMBERLYST 232WET has specifically been developed for heterogeneous acid catalysis of condensation and esterification reactions*.

The special process used to manufacture Amberlyst 232WET results in a particle size which confers enhanced hydraulics and reactivity

properties compared to conventional polymeric catalysts.

AMBERLYST 232WET is particularly well-suited for use in manufacture of bisphenol-A.

PROPERTIES

Physical form _____

Ionic form as shipped _____

Concentration of acid sites ^[1] _____Moisture holding capacity ^[1] _____

Shipping weight _____

Particle size _____

Harmonic mean size _____

Uniformity coefficient ^[1] _____Fines content ^[1] _____

Coarse beads _____

Light brown, spherical beads

Hydrogen

≥ 4.7 eq/kg

71 to 81 % (H⁺ form)720 g/L (45.0 lbs/ft³)

0.70 to 0.80 mm

≤ 1.20

< 0.425 mm : 0.5 % max

> 1.180 mm : 3.0 % max

^[1] Contractual value

Test methods are available on request

SUGGESTED OPERATING CONDITIONS

Maximum operating temperature _____

Minimum bed depth _____

Operating flow rate _____

Pressure drop limitation _____

130 °C (265 °F)

60 cm (24 inches)

1 to 8 BV**/h (LHSV)

1 bar (15 psig) across the bed

* U.S. Patent 5,233,096 (1993).

** 1 BV = 1 m³ solution per m³ of resin

All our products are produced in ISO 9002 certified manufacturing facilities.

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